

Technology Opportunity

Low Temperature Electronics

The National Aeronautics and Space Administration (NASA) seeks to transfer technology which will enable the operation of electronics at temperatures down to -235°C .

Potential Commercial Uses

- Superconducting motors and controls
- Low temperature medical diagnostic electronics
- Low temperature research electronics and sensors
- Astronomy electronics

Benefits

- Smaller, lighter, more flexible electronics and spacecraft
- Passive temperature control
- Non-nuclear/limited-nuclear spacecraft and probes for deep space
- Higher electrical efficiency

The Technology

The Power Technology Division at NASA Lewis Research Center is developing technology which will enable spacecraft to operate in the cold temperatures of deep space without the need for heating or with very little additional heating required. Presently, deep space missions employ electronics designed for room temperature (23°C) operation. As many as 100 heating units utilizing the heat produced by radioactive decay are required to maintain the 23°C internal temperature in a space environment that can fall below -235°C . Since these heater units always generate heat, they can produce almost as many problems as they solve. NASA Lewis is working toward eliminating the need for running the electronics at room temperature.

Components (such as capacitors, inductors, resistors, and transistors) are being characterized at temperatures ranging from room temperature to -235°C . By using components that operate from room

temperature to low temperatures, NASA Lewis is developing and testing circuits for operation in wider temperature ranges. Where present component technology is inadequate, NASA is developing new components which will perform at low temperatures. NASA is also working on low-temperature-only circuits which include superconducting components and structures.

NASA Lewis has developed dc/dc converters with four different circuit topologies which have operated from room temperature down to -196°C . Efficiency has been as high as 97 percent. Initial component characterization at NASA Lewis covered temperatures down to -196°C , while recent characterization has been extended down to -235°C . In the future, circuits will be tested down to -235°C . Similarly, fiber optic components have been characterized to -196°C , and tests will be extended down to -235°C .

Components with stable operation at low temperatures include Field Effect Transistors; complementary metal-oxide-semiconductor devices; metal film resistors; ceramic, solid tantalum, solid aluminum, and film capacitors; and superconducting and moly-permalloy-powder inductors. Some devices which did not operate satisfactorily at low temperature include silicon bipolar transistors, carbon resistors, and electrolytic and wet tantalum capacitors.

Options for Commercialization

Seeking a partner for commercialization and/or development. Possible Space Act Agreement.

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Key Words

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